CALIBRATION

[redacted]

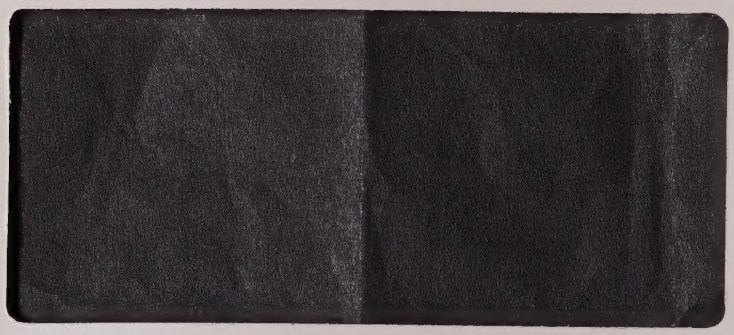
QT

• ELECTRONIC INSTRUMENTS

Quan-Tech

LABORATORIES INC.

WHIPPANY, N. J.



INSTRUCTION MANUAL

MODEL 2214

INTEGRATOR

for Serial No. 105

QUAN-TECH LABORATORIES, INC.

43 South Jefferson Road Whippany, N.J. 07981

TELEPHONE 201-887-5508

CLAIM FOR DAMAGE IN SHIPMENT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. We will then advise you of the disposition to be made of the equipment and arrange for repair or replacement. Include model number and serial number when referring to this instrument for any reason.

WARRANTY

Quan-Tech Laboratories, Inc. warrants each instrument manufactured by them to be free from defects in material and workmanship. Our liability under this warranty is limited to servicing or adjusting any instrument returned to the factory for that purpose and to replace any defective parts thereof. Electronic tubes and batteries are specifically excluded from any liability. This warranty is effective for one year after delivery to the original purchaser when the instrument is returned, transportation charges prepaid by the original purchaser, and when upon our examination it is disclosed to our satisfaction to be defective. If the fault has been caused by misadjustments, misuse, or abnormal conditions of operation, repairs will be billed at cost. In this case, an estimate will be submitted before the work is started.

Calibration checks of this instrument can easily be made in accordance with the instruction manual. Routine readjustments should never be attempted. If, however, the instrument has been damaged and requires recalibration or alignment, explicit calibration procedures as defined in the instruction manual must be followed.

If any fault develops, the following steps should be taken:

1. Notify us, giving full details of the difficulty, and include the model number and serial number. On receipt of this information, we will give you service data or shipping instructions.
2. On receipt of shipping instructions, forward the instrument prepaid, to the factory. If requested, an estimate of the charges will be made before the work begins provided the instrument is not covered by the warranty.

SHIPPING

The instruments should be packed in their original containers, or in a strong exterior container and surrounded by two inches of shock absorbing material.

Quan-Tech LABORATORIES

43 SOUTH JEFFERSON ROAD WHIPPANY, NEW JERSEY 07981

201-887-5508

TABLE OF CONTENTS

SECTION		PAGE
1.	General	
	A. Description	1-1
	B. Specifications	1-1
2.	Operation	
	A. Description of Controls	2-1
	B. Initial Operation	2-1
	C. Automatic Operation	2-2
3.	Theory of Operation and Circuit Description	3-1
	A. Theory of Operation	
	B. Circuit Description	
	1. Input Attenuator and Calibrate Amplifier	3-1
	2. Detector	3-2
	3. Integrator	3-2
	4. Meter Driver	3-2
	5. Trigger Delay	3-2
	6. Integration Time	3-3
	7. +15 Volt Power	3-3
	8. -18 Volt Power	3-3
4.	Maintenance and Calibration	
	A. General	4-1
	B. Removal of Top and Bottom	4-1
	C. Input Power	4-1
	D. Calibration	4-2

LIST OF ILLUSTRATIONS

FIGURE		PAGE
4-1	Input Voltage Terminal Strip	4-2
4-2	Voltage Chart	
4-3	Printed Circuit Board Connector Lug Identification	
	Block Diagram	
	Schematics	

SECTION 1

GENERAL

A. DESCRIPTION

The Model 2214 INTEGRATOR was designed for use with other Quan-Tech Laboratories noise measuring equipment to reduce operator fatigue and error in recording noise readings. The INTEGRATOR connects to the noise output of the major measuring equipment and provides the operator with a stable meter reading. The meter readings (or analog voltage output) will be statistically correct within definable limits which are governed by the integration time selected and the bandwidth of the noise source.

Provision has been made to calibrate the INTEGRATOR over a wide range of RMS input signal. Outputs are available at a rear connector for use with automatic equipment.

B. SPECIFICATIONS

Frequency Response:	10 cps to 100 Kc
Input Signal:	10 mv. RMS to 1 volt RMS through the combined use of the CAL. adjust and 10:1 fixed input attenuator.
Input Impedance:	Approximately 50K ohms.
Integration Time:	Front panel select; 3, 10 and 30 seconds.
Accuracy:	Instrument accuracy; ± 3% of full scale. Statistical accuracy determined by selected integration time and equivalent noise bandwidth of noise source. Fully covered in SECTION 3 of manual.
Analog Output:	0 to 10 VDC, proportional to front panel meter reading.
Automatic Start:	Switch closure to ground required.
Meter Range:	Full scale sensitivity is calibrated to be that of the master equipment.
Power Input:	117/234 volts, 50-60 cps. 8 watts.
Dimensions:	3 3/8"W x 7"H x 13 3/4"D behind panel.
Weight:	6½ pounds

SECTION 2

OPERATION

A. DESCRIPTION OF CONTROLS

1. SECONDS: This three position switch selects the duration of time over which the input signal is integrated before being presented as a meter reading.

2. CAL.; X1, X10 : These controls are provided to permit calibration over a wide range of input voltage. The basic approach in calibration is to make the INTEGRATOR panel meter read the same as the corresponding meter on the master equipment. The controls may be used in any combination to achieve this calibration end.

3. NOISE meter: The panel meter provides both 1 and 3 scales to allow direct reading with any multiples of 1 and 3 corresponding to the full scale sensitivities of the master equipment.

   This meter displays the noise measurement made the last time the integrating cycle was run. Each time a new reading is desired the INTEGRATOR must receive a START command. The previous reading will be within instrument accuracy for a number of minutes.

4. START: The bat handle START switch provides the means of manually starting a cycle of integration and readout. If the START switch is depressed in the middle of a cycle of operation the cycle will simply start over.

B. INITIAL OPERATION

1. Set-up: Connect the Model 2214 INTEGRATOR to a suitable power source as described on the identification plate at the rear of the equipment near the power cord. Place the front panel power switch to ON. Connect the input noise signal to the indicated terminals or connector on the rear plate of the instrument. (A suitable signal source is the NOISE OUTPUT from any frequency channel of any of the Quan-Tech Laboratories noise analyzers).

2. Calibration: THE MODEL 2214 INTEGRATOR MUST ALWAYS BE CALIBRATED WITH THE PARTICULAR SIGNAL SOURCE TO BE MONITORED. The panel meter on the INTEGRATOR is calibrated to read the same as the corresponding meter of the master equipment. Both the CAL. and the X1, X10 controls are used to accomplish this calibration. In general, the X1, X10 switch will be on X1 for RMS input signals below 100 millivolts and on X10 for RMS input signals between 100 millivolts and 1 volt. The following is a step by step calibration procedure using a 1Kc noise channel(1Kc NOISE OUTPUT from one of the QTL noise analyzers) and a sine wave generator.

B. INITIAL OPERATION (Cont'd)

2. Calibration (Cont'd):

a) Apply sufficient 1Kc signal to the input of the master equipment (in the manner described for calibration of that equipment), to give a full scale meter deflection on the 1 microvolt/root cycle range.

b) Set the INTEGRATOR SECONDS switch to the 3 second position, the X1, X10 input attenuator switch to the X1 position and depress the START switch.

c) In about 4 seconds the INTEGRATOR panel meter should read up scale. Adjust this reading for full scale deflection using the CAL control. [illegible]. Note that a change of CAL. control does not change the previous meter reading but will cause the next reading to be different when the START switch is operated again. A few cycles of START and adjust are required for proper calibration.

The same procedure is followed if a noise signal is used for calibration. A Quan-Tech Laboratories Model 420 RANDOM NOISE GENERATOR may be substituted for the sine wave generator in the above. It is usually advisable to calibrate at approximately mid-scale when using a noise source because of the necessity to integrate by eye on the master equipment.

In the absence of external generators the INTEGRATOR may be calibrated at the normal reading level by simply adjusting the CAL. control for the same reading on the INTEGRATOR as on the master equipment.

When calibrating on noise it is best to achieve approximate calibration on the 3 second time then move to the 30 second integration time to reduce statistical error. (Statistical error is inversely proportional to the square root of the integration time. (See SECTION 3A for further discussion of error).

C. AUTOMATIC OPERATION

Switch closures for integration time identification; 0 to 10 volt DC meter analog, and automatic START are provided to permit use with an automated system. The automatic START requirement is a switch closure to ground.

SECTION 3

THEORY OF OPERATION AND CIRCUIT DESCRIPTION

A. THEORY OF OPERATION

The Model 2214 INTEGRATOR is basically a wide band operational amplifier used as a total integrator for controlled periods of time.

Probable statistical error in a total integrator is inversely proportional to the square root of the product of the integration time and the noise bandwidth.

A sample computation of probable error follows, using typical numbers for the 10 cycle noise channel of the Quan-Tech Laboratories Model 327 DIODE NOISE ANALYZER and the 30 second time on a Model 2214 INTEGRATOR:

$$\text{error} = (\text{noise BW} \times \text{int. time})^{-\frac{1}{2}}$$

$$= (10 \text{ cps} \times 30 \text{ sec.})^{-\frac{1}{2}}$$

$$\text{error} = 0.058$$

The statistical meaning of the above computation is that the error will be less than $\pm$ 5.8 per cent, 68 per cent of the time. This probable error can also be stated as being less than $\pm$ 11.6 per cent, 95 per cent of the time or approximately $\pm$ 1 db, 95 per cent of the time.

B. CIRCUIT DESCRIPTION

1. General

The Block Diagram, T-4880 , indicates the interconnection of the individual circuits contained in the instrument. Reference to this diagram and the appropriate schematic diagram will enable the reader to follow the individual circuit descriptions. In general, each block shown on T-4880 represents a complete circuit which has been packaged on a plug-in printed circuit board.

2. Input Attenuator and Calibrate Amplifier

The Input Attenuator is a simple 10 to 1 resistive divider used to reduce by 10 the gain range required for calibration.

The Calibrate Amplifier provides the variable gain required to calibrate at any RMS input signal level within the specified limits.

B. CIRCUIT DESCRIPTION (Cont'd)

2. Input Attenuator and Calibrate Amplifier (Cont'd)

This amplifier is actually made up of two similar two transistor amplifiers whose gain is adjusted with the front panel CALIBRATE control . Each of these amplifier sections employs negative feedback resulting in stable operating characteristics.

3. Detector

The function of the Detector circuit is to provide full wave signal information to the Integrator circuitry.

The basic configuration of the Detector is that of a three stage, unity voltage gain, feedback amplifier. Full wave signal information is obtained by monitoring the output current of each of the push-pull output transistors.

4. Integrator

The Integrator circuit consists of gain determining series resistors which are selected with the INT. TIME switch, the storage capacitor and a high gain operational amplifier which provides the linear current drive required for integration. The operational amplifier is a three stage amplifier employing differential input detection.

The drive to the storage element and the capability to receive or hold a charge are automatically controlled by the sequencing circuitry through reed relays.

5. Meter Driver

The Meter Driver circuit is a unity gain d-c amplifier which provides the impedance conversion required to drive the panel meter and low impedance ANALOG OUTPUT. The ANALOG OUTPUT provides 0-10 VDC at 1K ohm source impedance for automatic recording equipment.

The sequencing circuitry automatically disconnects both the ANALOG OUTPUT and the panel meter at times when the correct reading is not available.

6. Trigger Delay

This monostable circuit remains in a steady state until it receives a trigger pulse at the base of a normally on transistor. Once receiving a trigger pulse, the transistor changes state for an interval of time prescribed by the time constants of the circuit. The two central transistors drive isolating stages whose outputs are used for high current switching.

B. CIRCUIT DESCRIPTION (Cont'd)

7. Integrator Time

This circuit is similar in operation to the Trigger Delay card assembly. The exception in its operation is that it receives a reset pulse just prior to a trigger to begin its change of state cycle. The reset pulse insures that the state of the circuit is receptive to a start pulse.

8. +15 VDC Power

The +15 volt supply obtains its reference from a Zener diode. The zener reference is compared to a voltage determined by a resistive divider. The amplified error drives a series regulating transistor which maintains a constant output voltage. Additional line regulation is achieved through the use of an additional zener diode.

9. -18 VDC Power

The -18 volt supply operates in a manner similar to the +15 volt unit. The exception is that in this case the positive output is grounded common.

SECTION 4

MAINTENANCE AND CALIBRATION

A. GENERAL

The philosophy of design of both circuits and components in the Model 2214 has been conservative, and therefore should provide long and trouble free operation.

If, however, the instrument has been damaged and needs extensive repair, the Warranty page of this manual should be consulted for instructions.

In the event that minor servicing is required and the instrument is opened, the following instructions should be followed. DO NOT CHANGE ANY INTERNAL ADJUSTMENTS without a knowledge of its function.

B. REMOVAL OF TOP AND BOTTOM

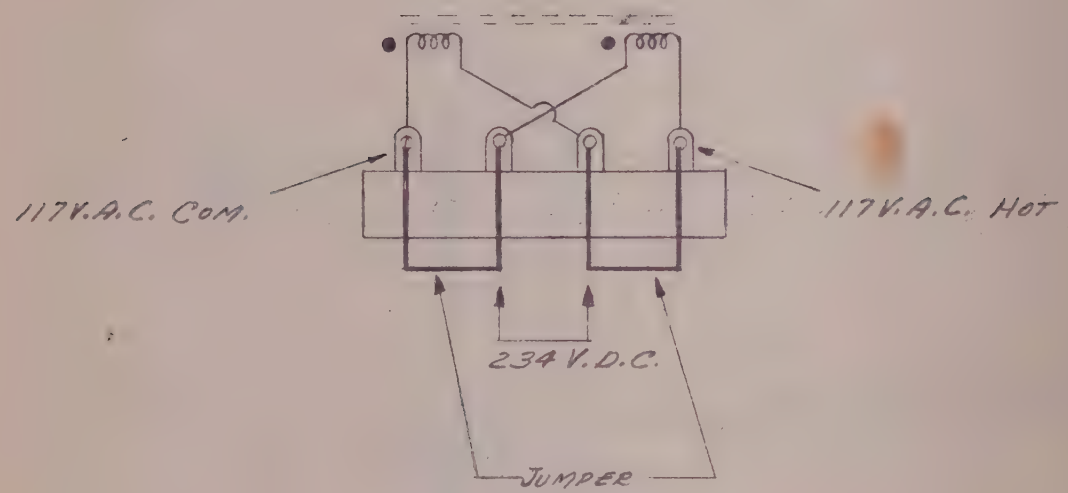
Remove six screws each on the top and bottom plates to gain access to the inside of the equipment.

C. INPUT LINE POWER

This instrument has been designed to operate from either a 117 volt or a 234 volt AC power source. The plate on the rear of the instrument near the power cord indicates the voltage at which the instrument should be operated. If the input voltage must be changed, the procedure given should be followed:

1. Remove the bottom cover.
2. Change the transformer primary connections by moving the jumpers on the 4 terminal solder strip located in front of the line cord as indicated in Figure 4-1.
3. Reverse the plate on the rear of the instrument to indicate the new voltage connections.
4. Replace the bottom cover.

C. INPUT POWER LINE (Cont'd)



D. CALIBRATION

1. Integration Time:

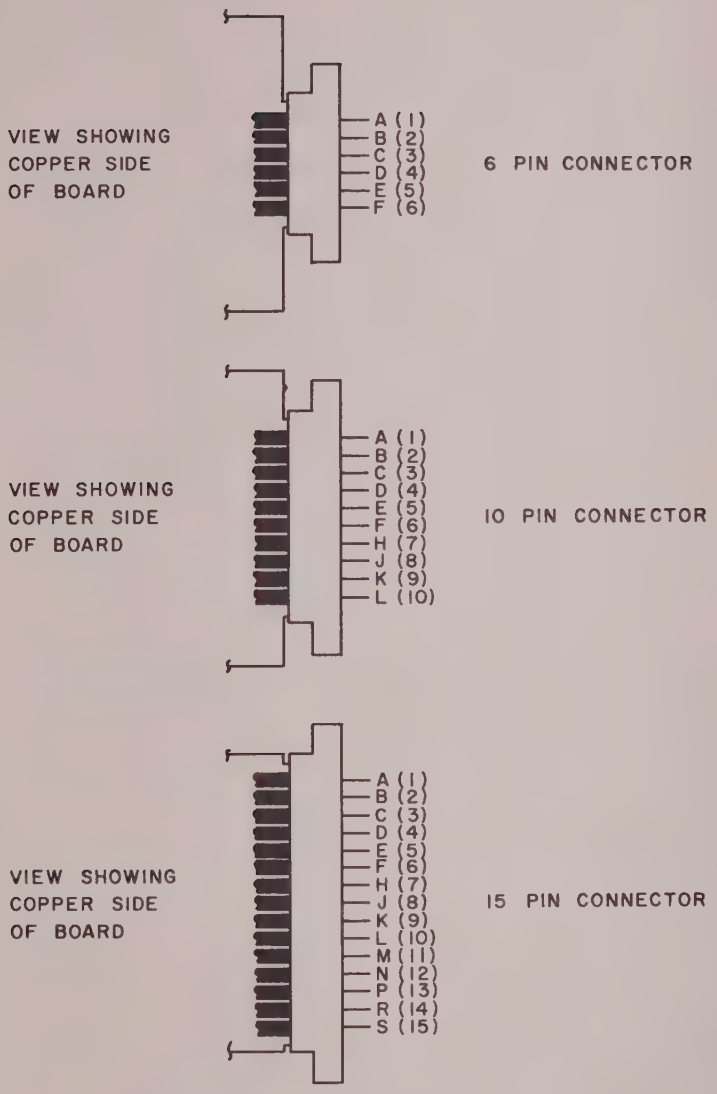
This adjustment is made to compensate for the capacity tolerance of the timing capacitor. Adjustment is made in the following manner:

a) Using a SCOPE having a calibrated time base and capability of external sweep triggering, connect pin 2 of the INT. TIME assembly #4893 to SCOPE external trigger and pin 7 of assembly #4893 to SCOPE horizontal input.

b) Depress START switch and observe a positive gate whose duration is either 3, 10 or 30 seconds as selected by the SECONDS switch on the Model 2214 front panel.

c) Set the SECONDS switch to 30 seconds and adjust the variable resistor calibrate control on assembly #4893 for a 30 second positive gate at pin 7 when the START switch is depressed. (A small offset screwdriver is required for this adjustment).

NOTE: Scope timing accy. must be verified, before proceeding with calibration



PRINTED CIRCUIT BOARD CONNECTOR LUG IDENTIFICATION

SCHEMATIC LEGEND

k = 1000

⊘ = Screw Driver Adjustment

▭ = Front Panel Control

* = Factory Select

Unless Otherwise Specified:

All Resistances in Ohms

All Resistors 1/2 Watt

All Capacitances in Microfarads

SEMICONDUCTOR LEGEND

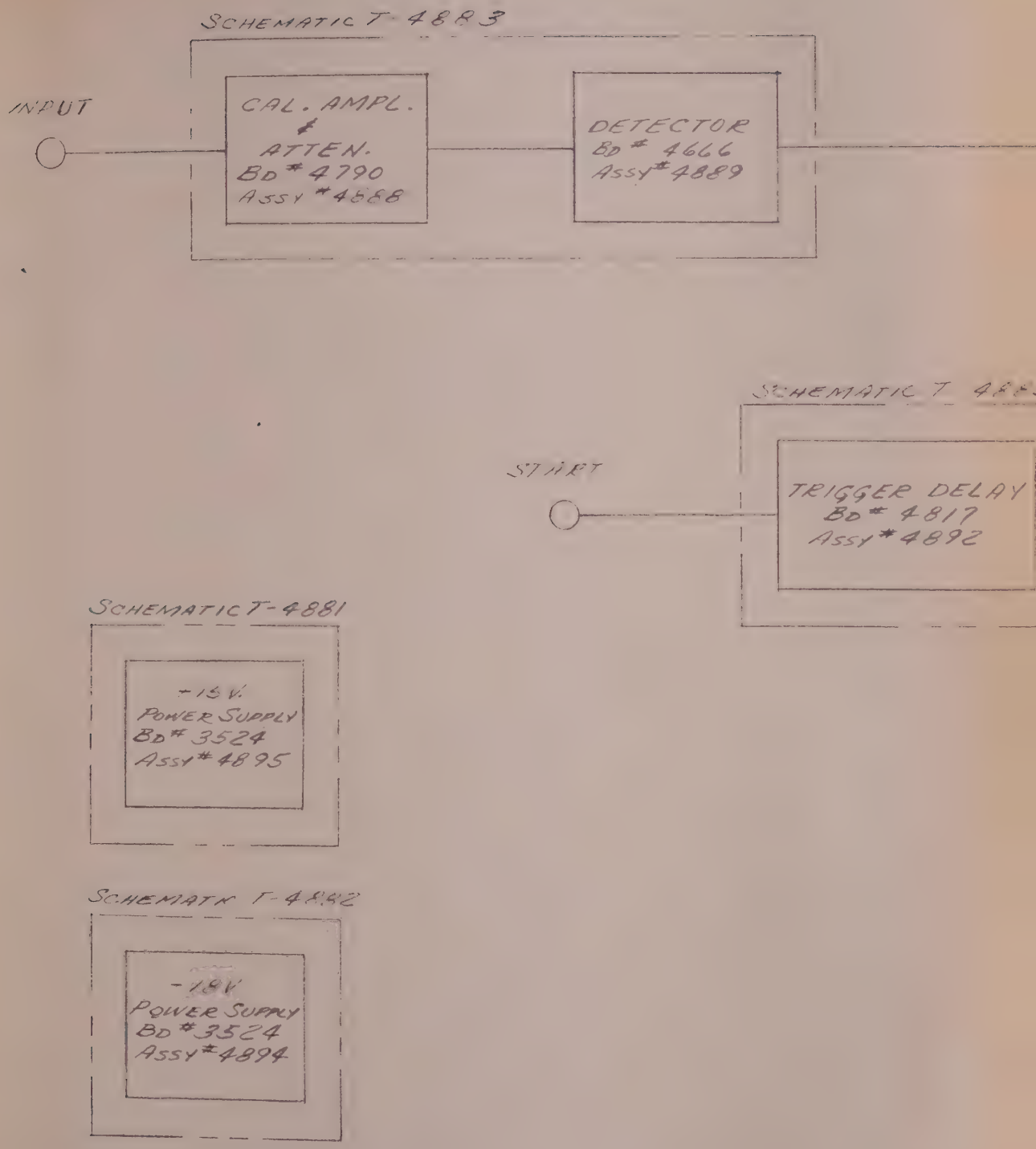
Changes and improvements in the semiconductor products available for commercial use necessitate type changes from time to time. To eliminate confusion and costly paperwork, many of these changes will be covered in the following legend. The purpose of this legend is to acknowledge the fact that the type number on a semiconductor found in a piece of equipment will not necessarily correspond with the type number given on the schematic diagram.

The legend is not intended to be an interchangeability list although in many cases good quality components* within a given category may be substituted with acceptable results. Normally, replacements should be made using components having the same type number as the component being replaced.

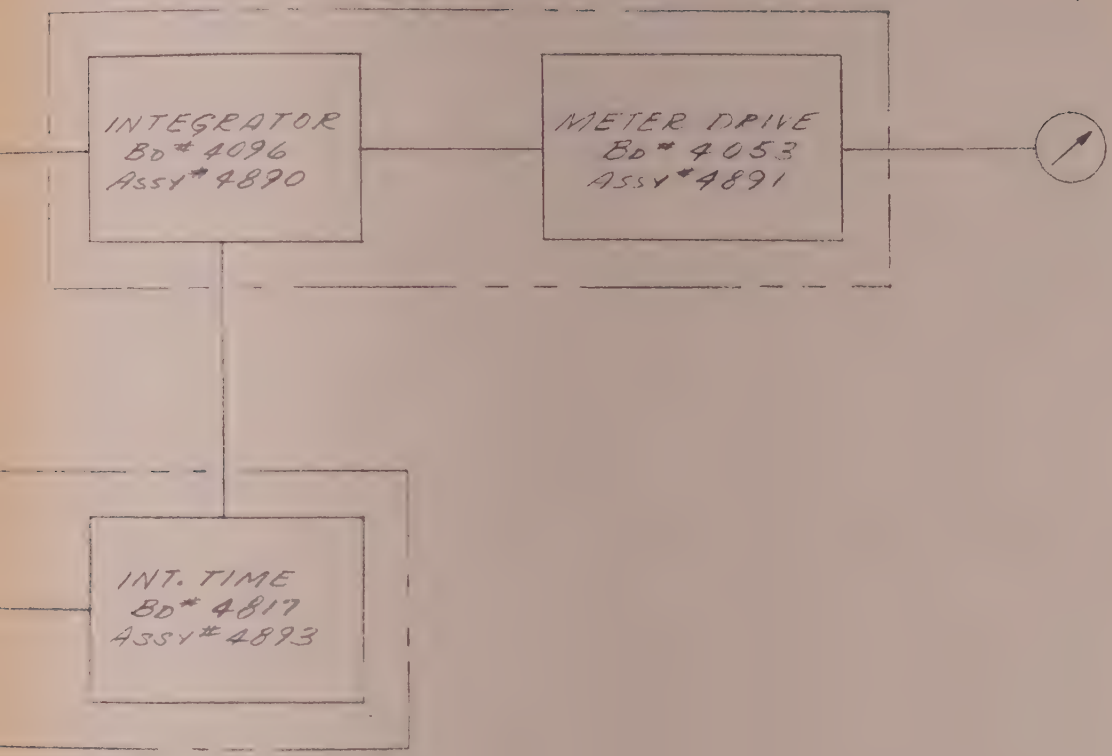
Those components bearing an asterisk on the schematic diagram are factory selected components and should be obtained from Quan-Tech Laboratories.

*It should be noted that the incoming inspection procedure followed at Quan-Tech Laboratories includes noise screening on most semiconductors.

TYPE # ON SCHEMATIC	TYPE # IN EQUIPMENT
2N414	2N396A, 4JX1G759, 4JX1D653
2N396A	4JX1G759, 4JX1D653
T1480	2N1613
T1494	2N1613
2N2603	2N3250
2N929	220N2
2N2219	220N2
1N2859	1N3253, 1N3254
1N2862	1N3254
1N709	1N753

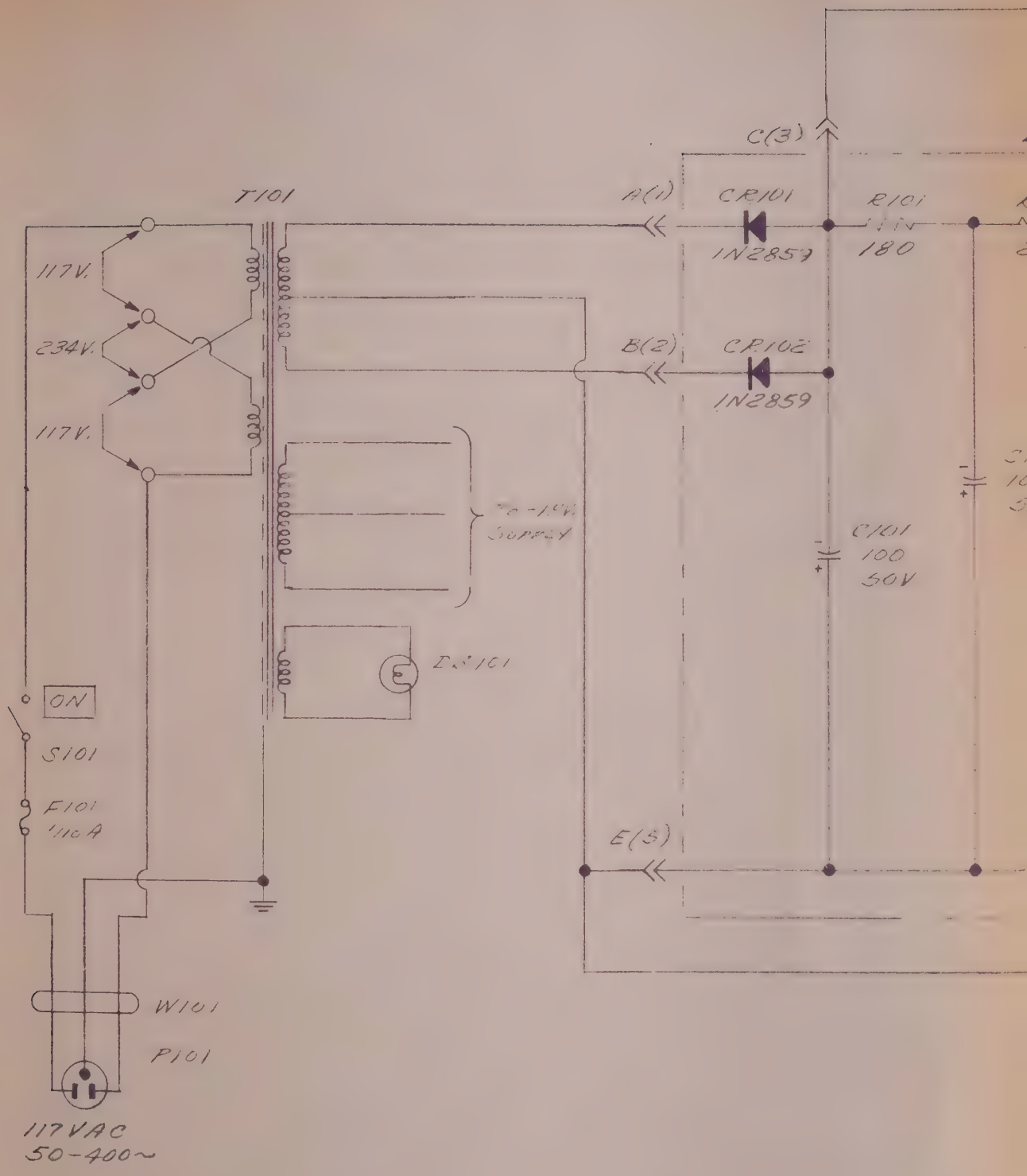

SCHEMATIC T-4883
INPUT
CAL. AMPL.
&
ATTEN.
Bd # 4790
Assy # 4688
DETECTOR
Bd # 4666
Assy # 4889
SCHEMATIC T 488
START
TRIGGER DELAY
Bd # 4817
Assy # 4892
SCHEMATIC T-4881
+15 V.
POWER SUPPLY
Bd # 3524
Assy # 4895
SCHEMATIC T-4882
-15V
POWER SUPPLY
Bd # 3524
Assy # 4894

SCHEMATIC T-4884

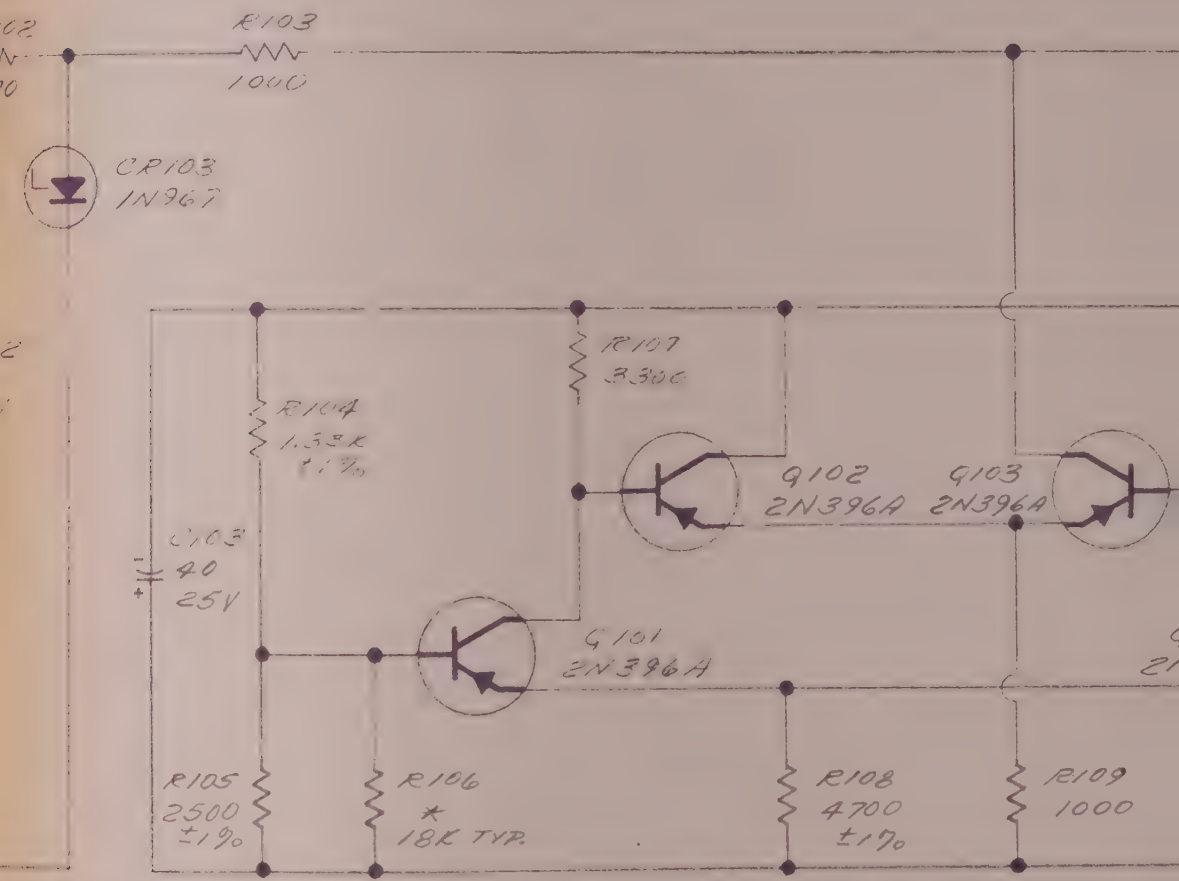


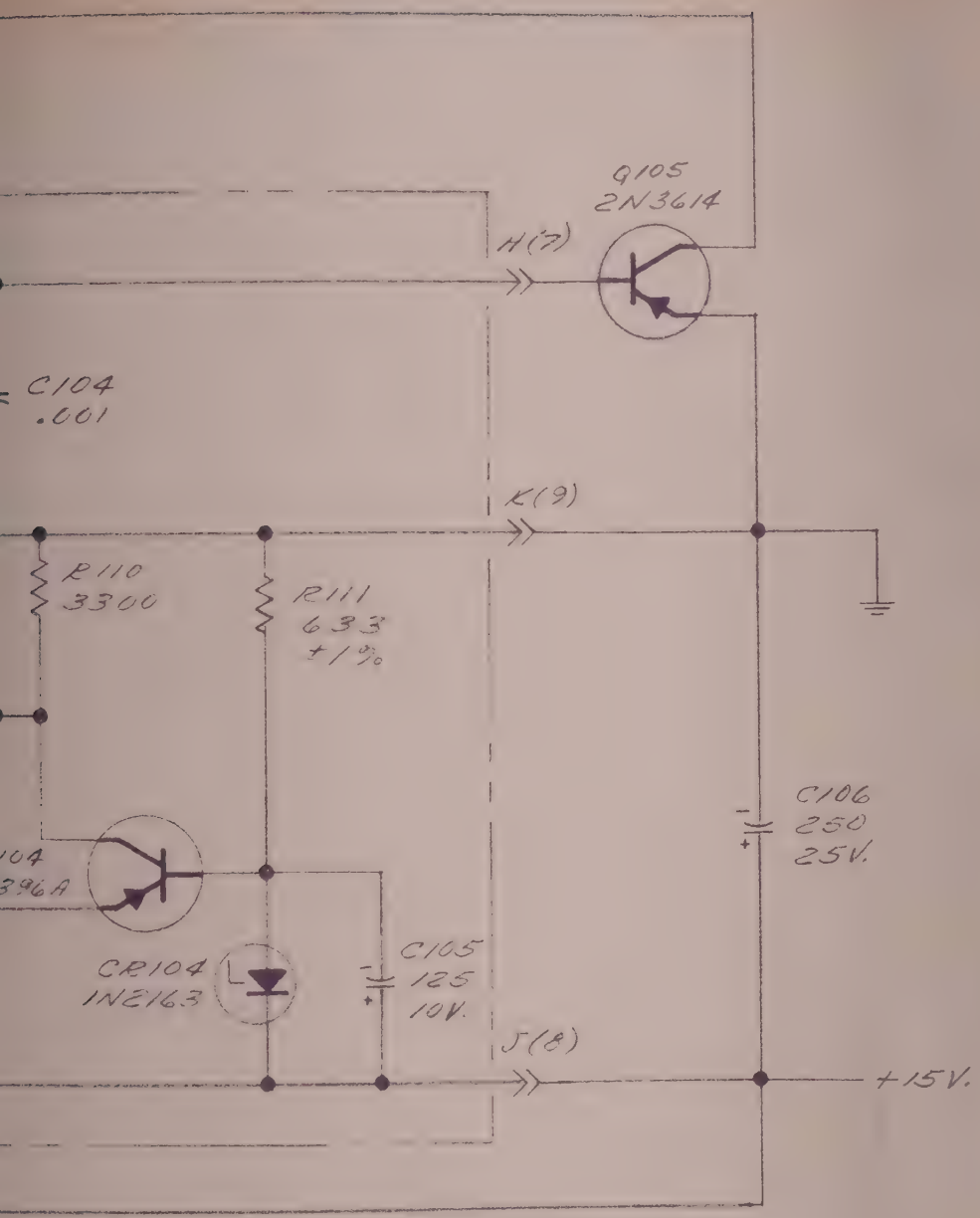
BLOCK DIAGRAM
INTEGRATOR
MODEL 2214

T-4880-A


C(3)
T101
A(1)
CR101
IN2859
R101
180
117V.
234V.
117V.
B(2)
CR102
IN2859
C101
100
50V
E(3)
ON
S101
F101
1/10 A
W101
P101
117VAC
50-400~

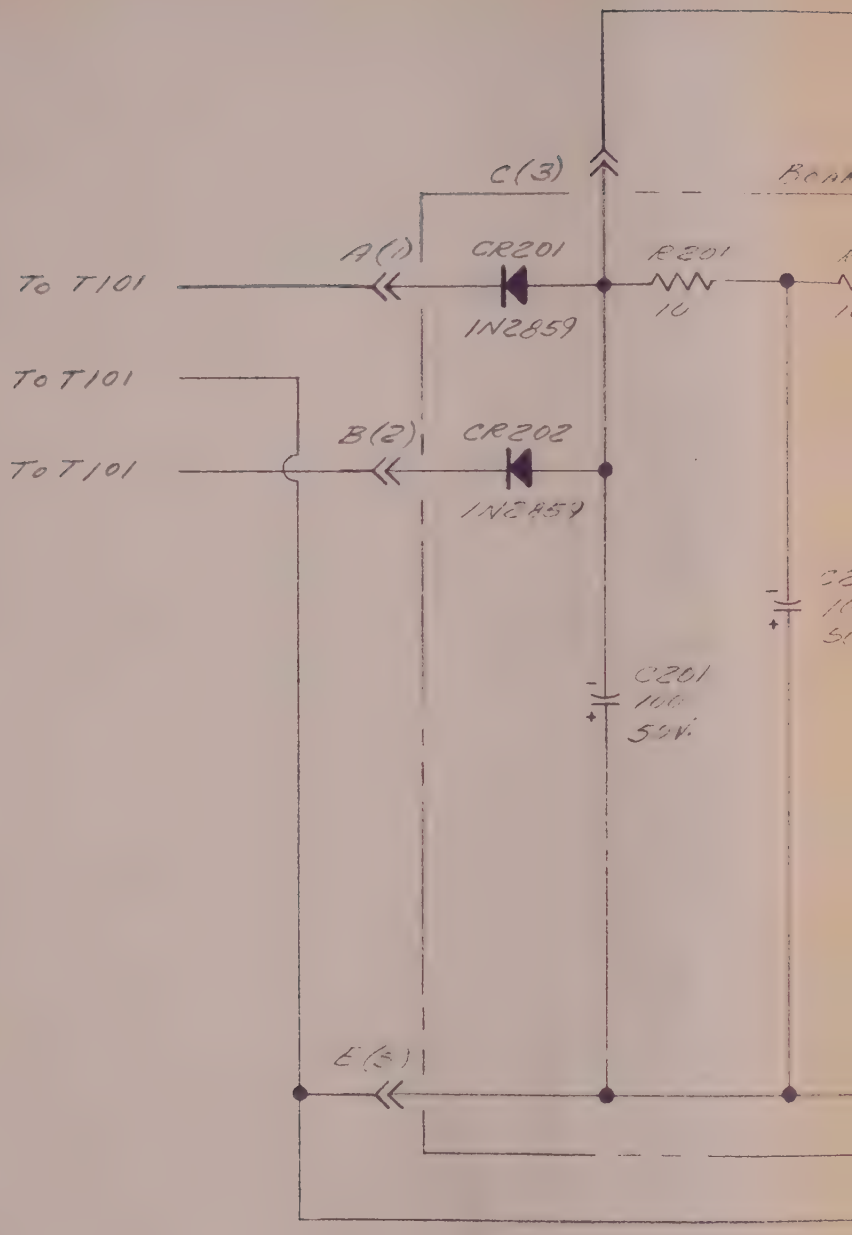
OARD #3524 ASSY #4895



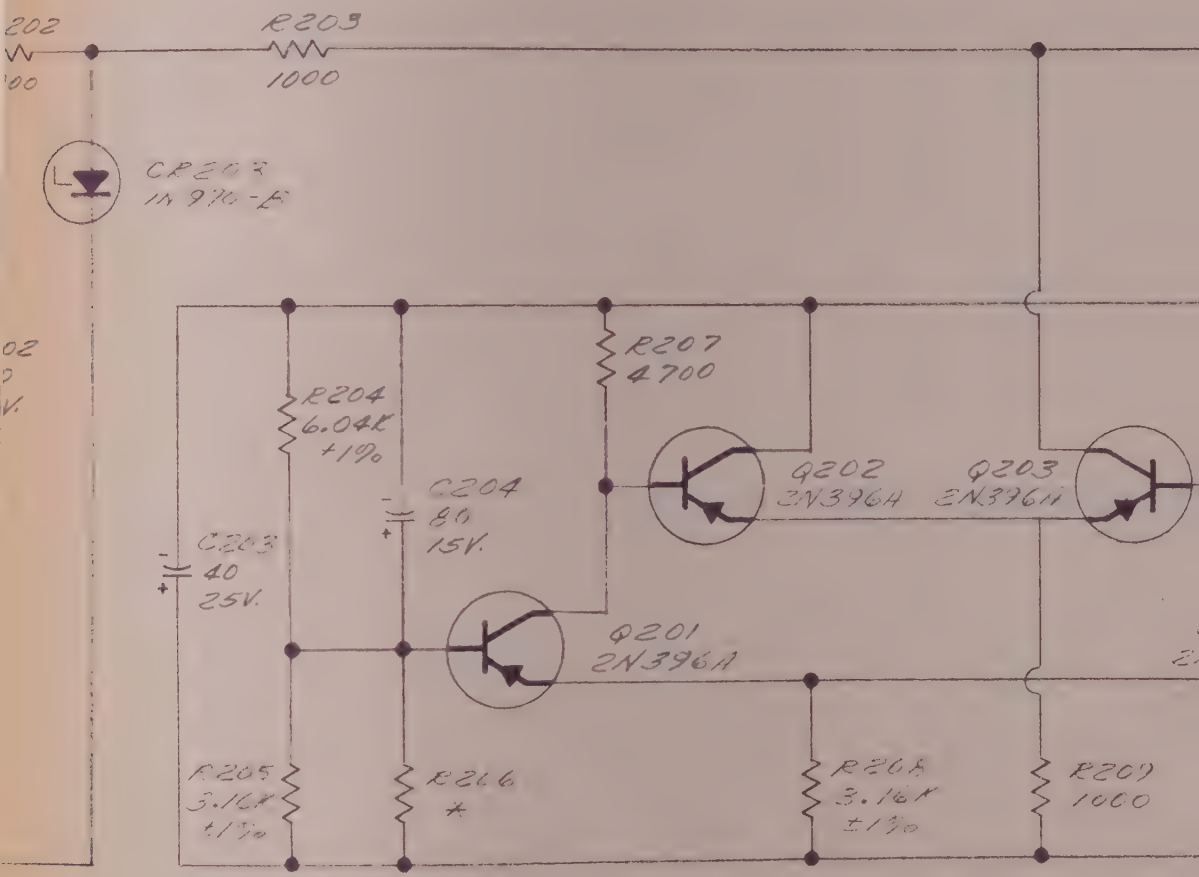


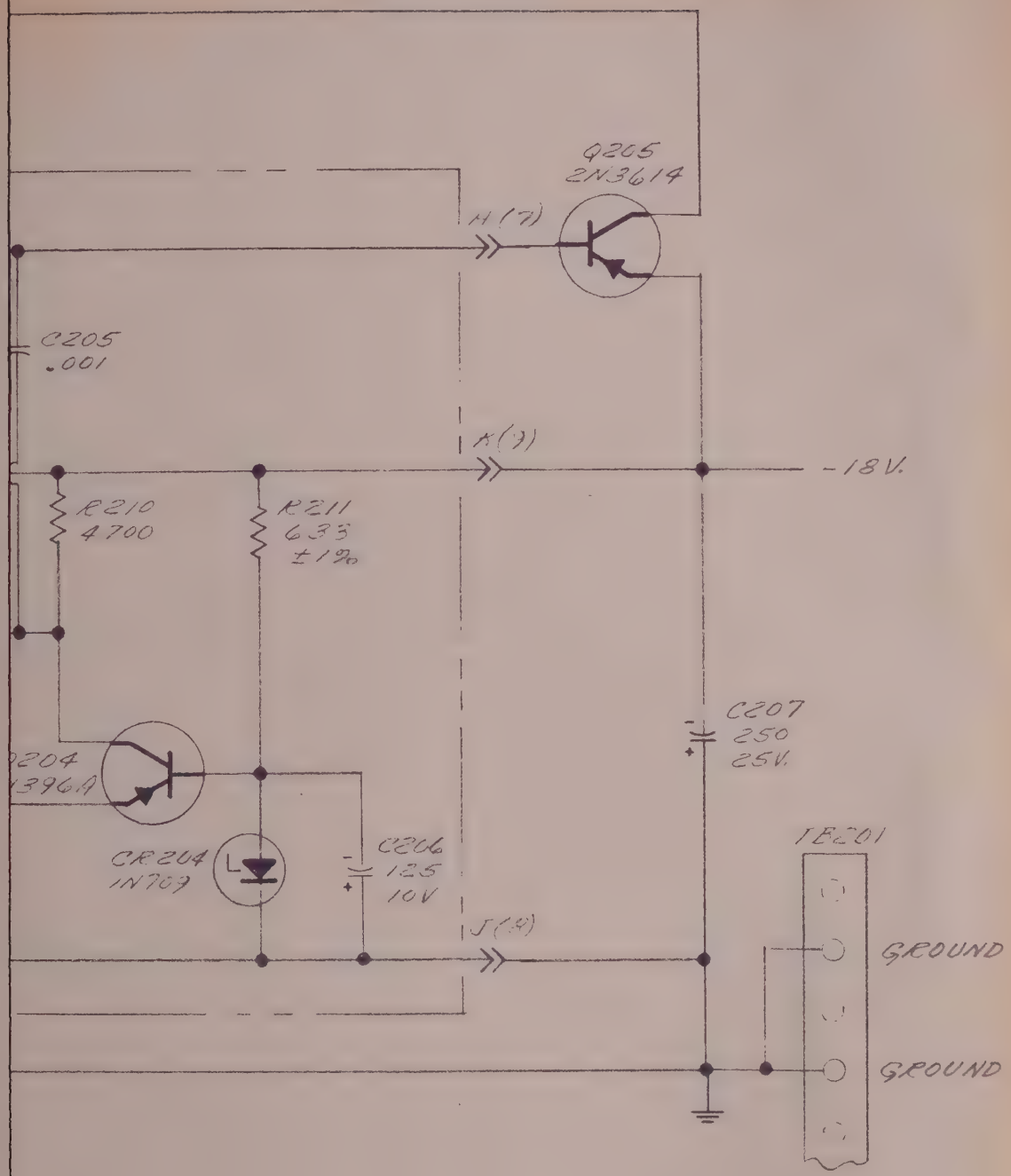
SCHEMATIC
+15 V. SUPPLY
MODEL 2214

T-4881-A


C(3)
A(1)
CR201
R201
10
1N2859
To T101
To T101
B(2)
CR202
To T101
1N2859
C201
100
50V.
E(5)

#3524 Assy #4894

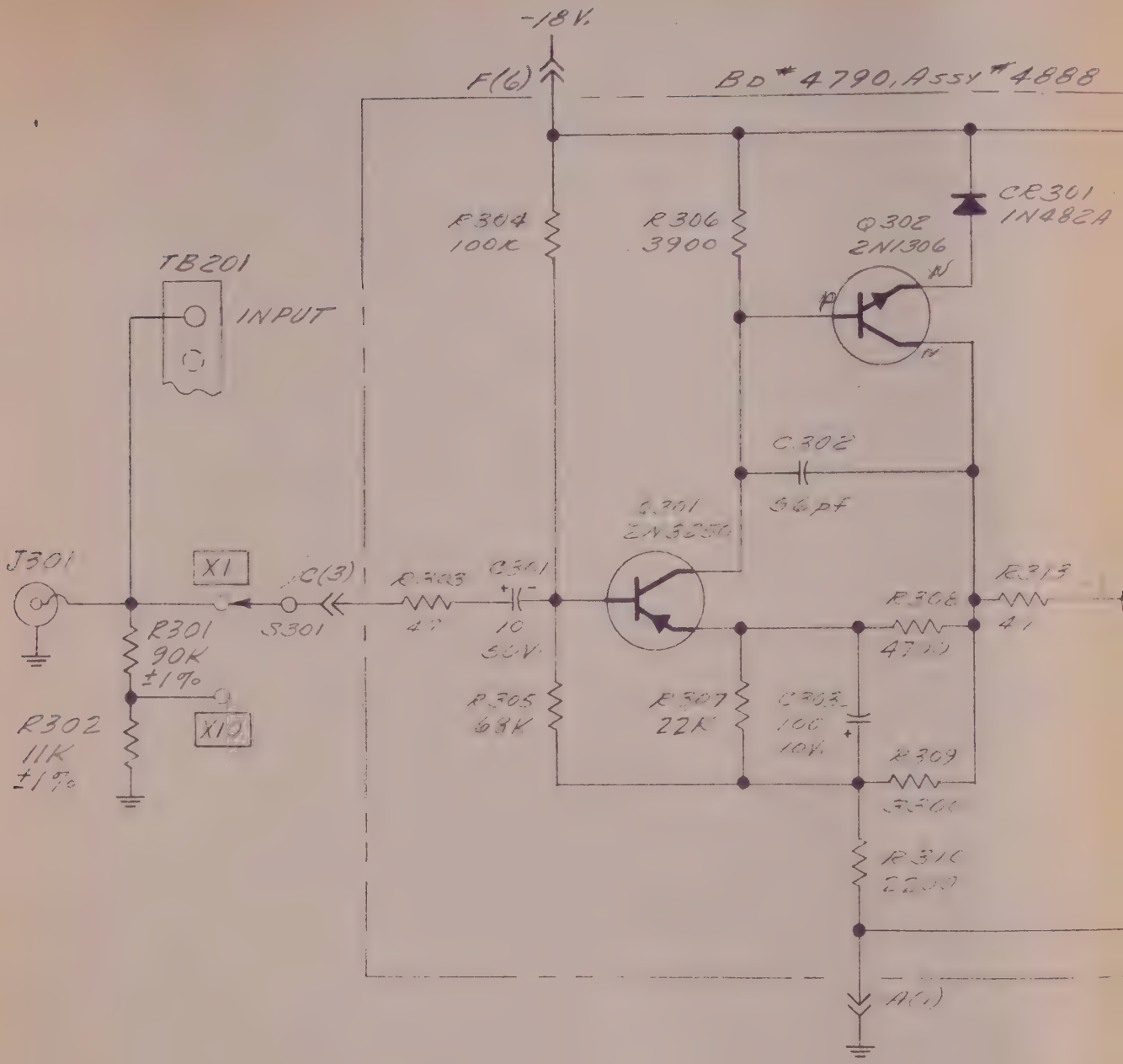




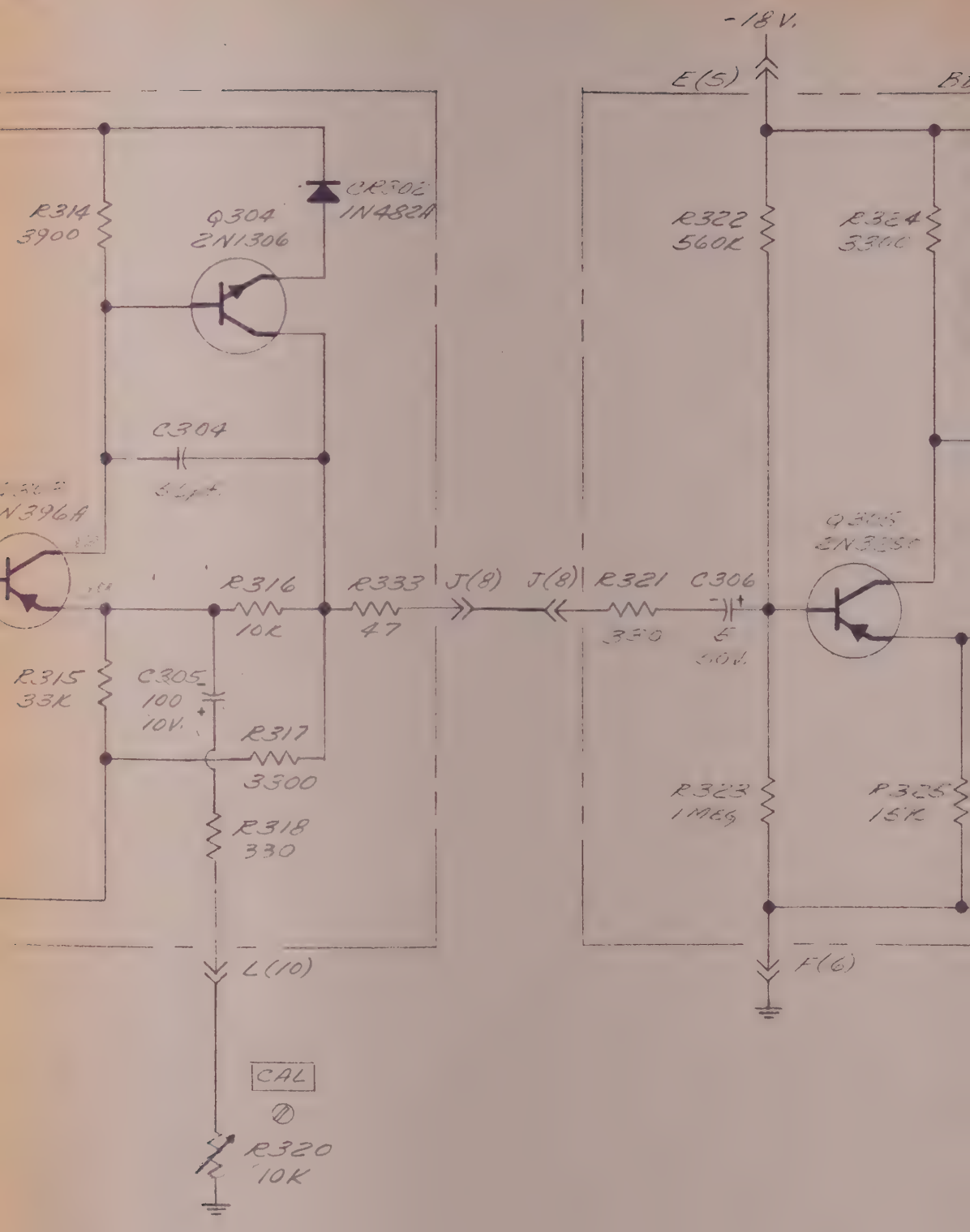
SCHEMATIC
-18 V. SUPPLY
MODEL 2214

T-4882-A

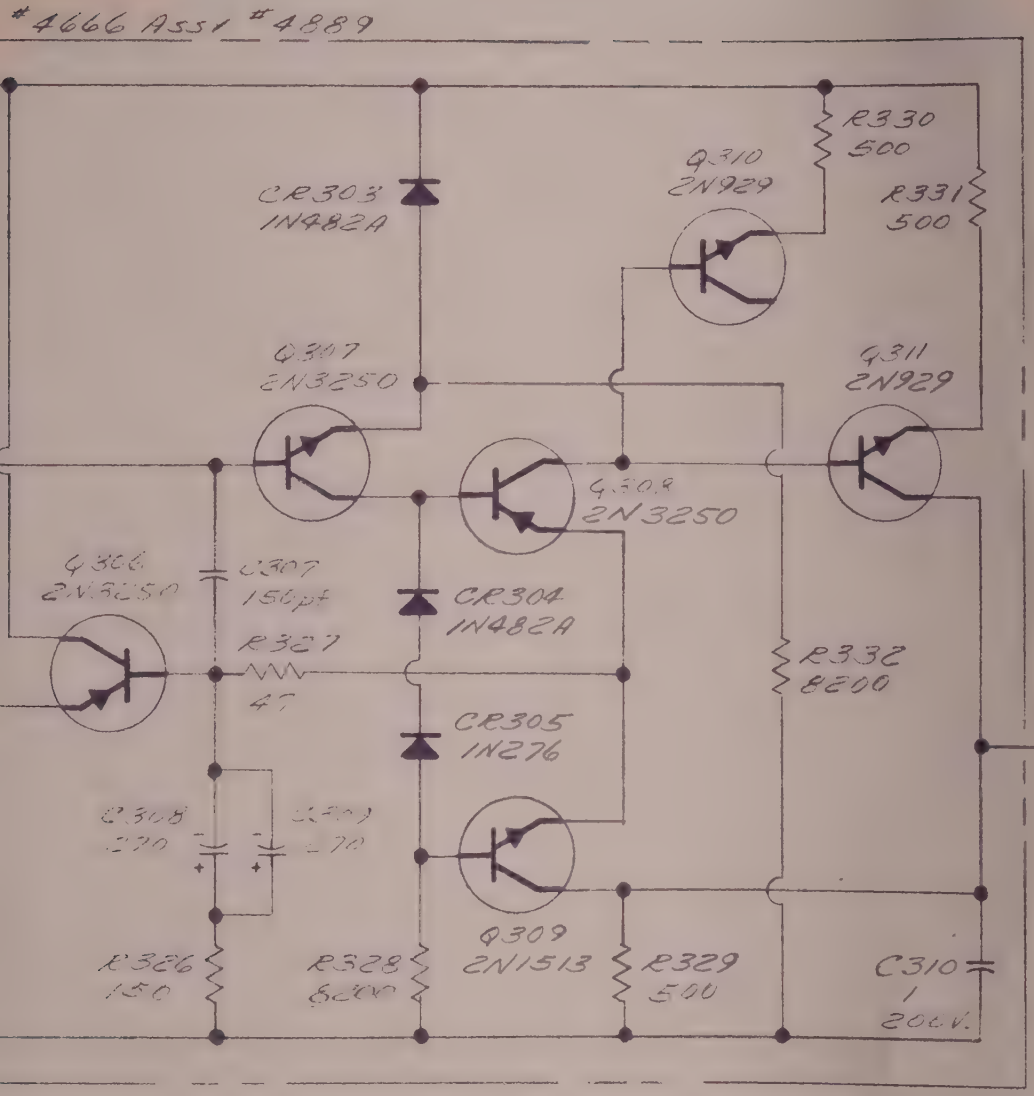
CALIBRATE AMPLIF



ER

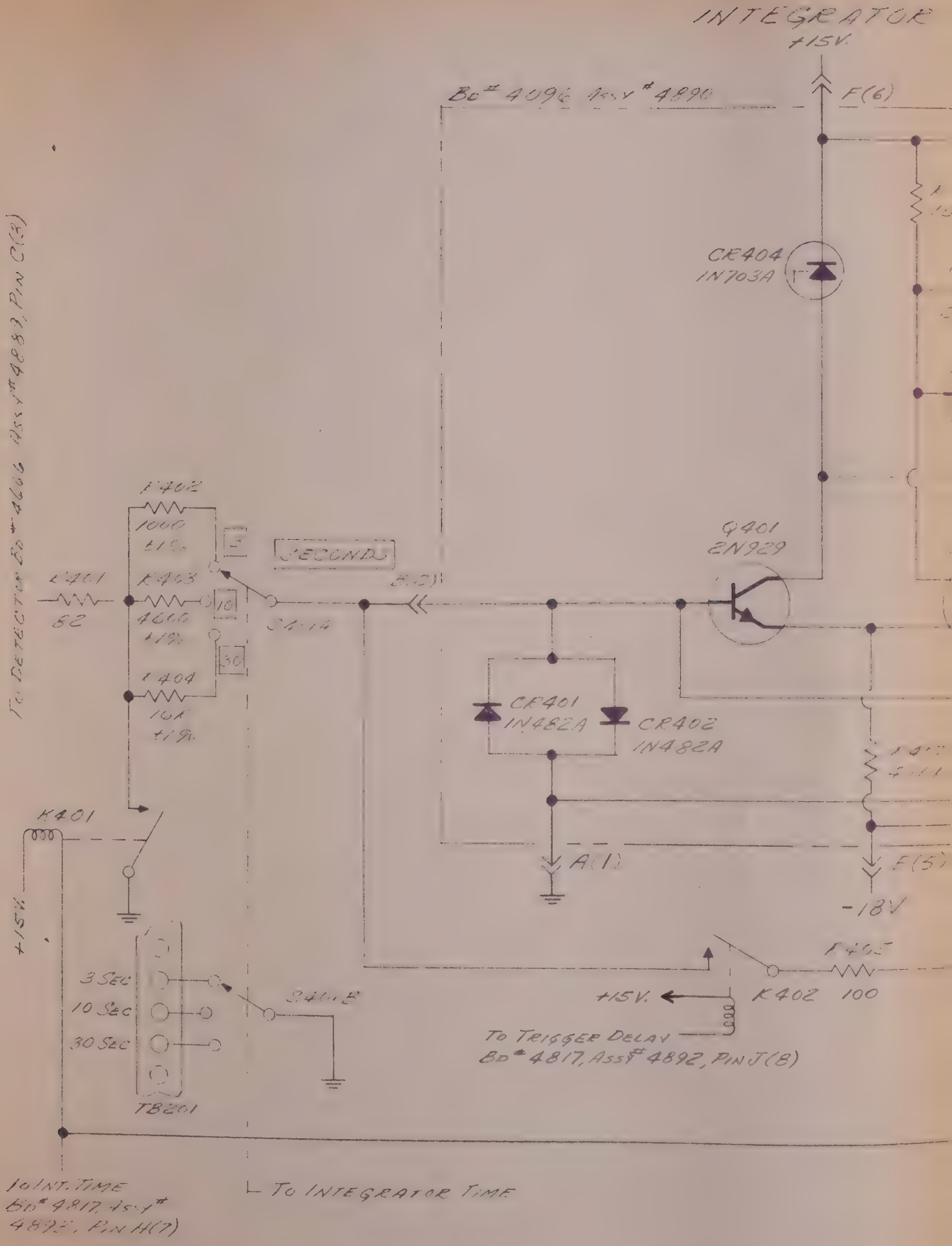

-18 V.
E(5)
R314
3900
Q304
2N1306
CR302
IN482A
R322
560K
R324
3300
C304
Q305
2N3251
R316
10K
R333
47
J(8)
J(8)
R321
3300
C306
5
10V.
R315
33K
C305
100
10V.
R317
3300
R318
330
R323
1 MEG
R325
15K
L(10)
F(6)
CAL
R320
10K

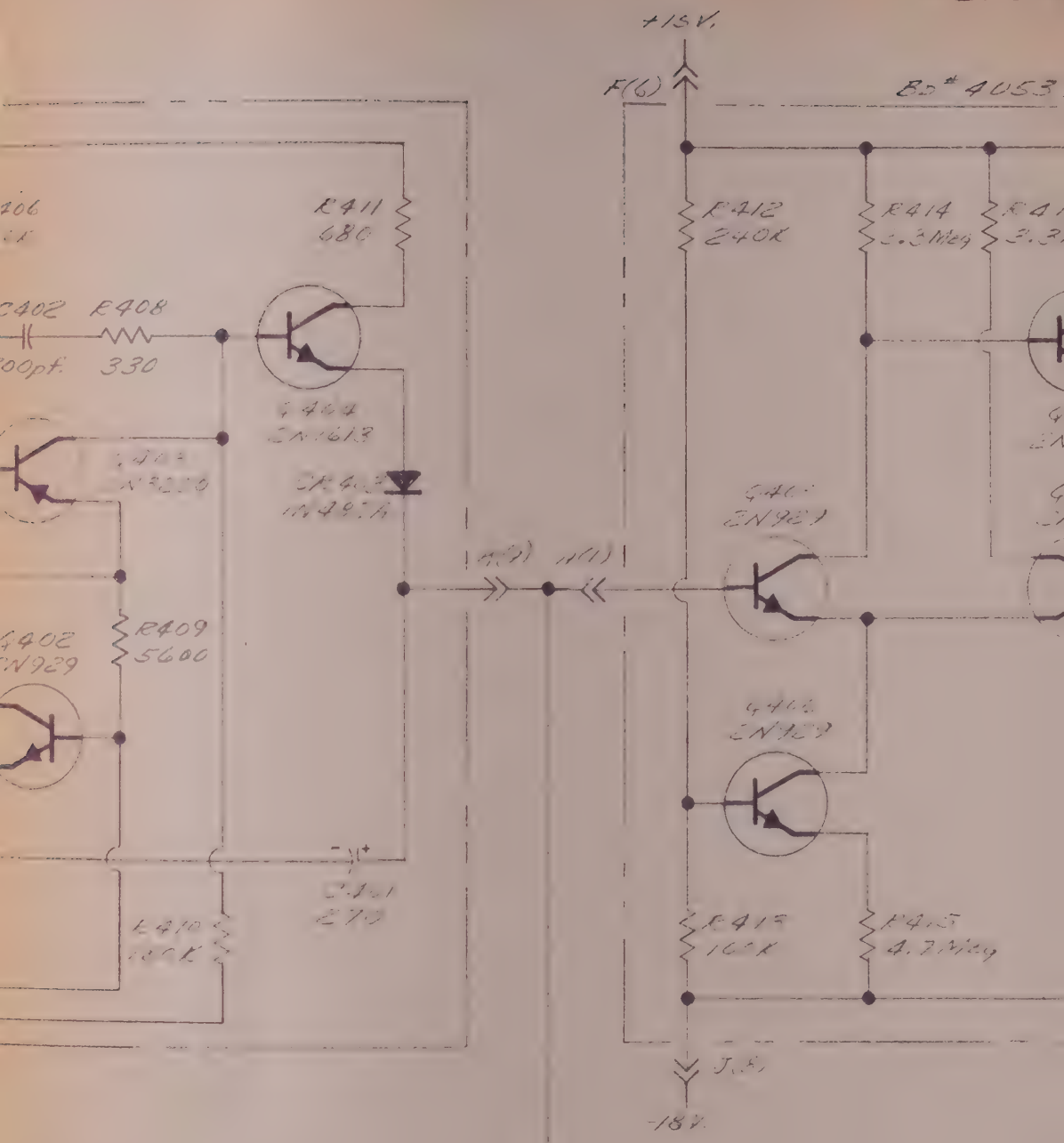
DETECTOR



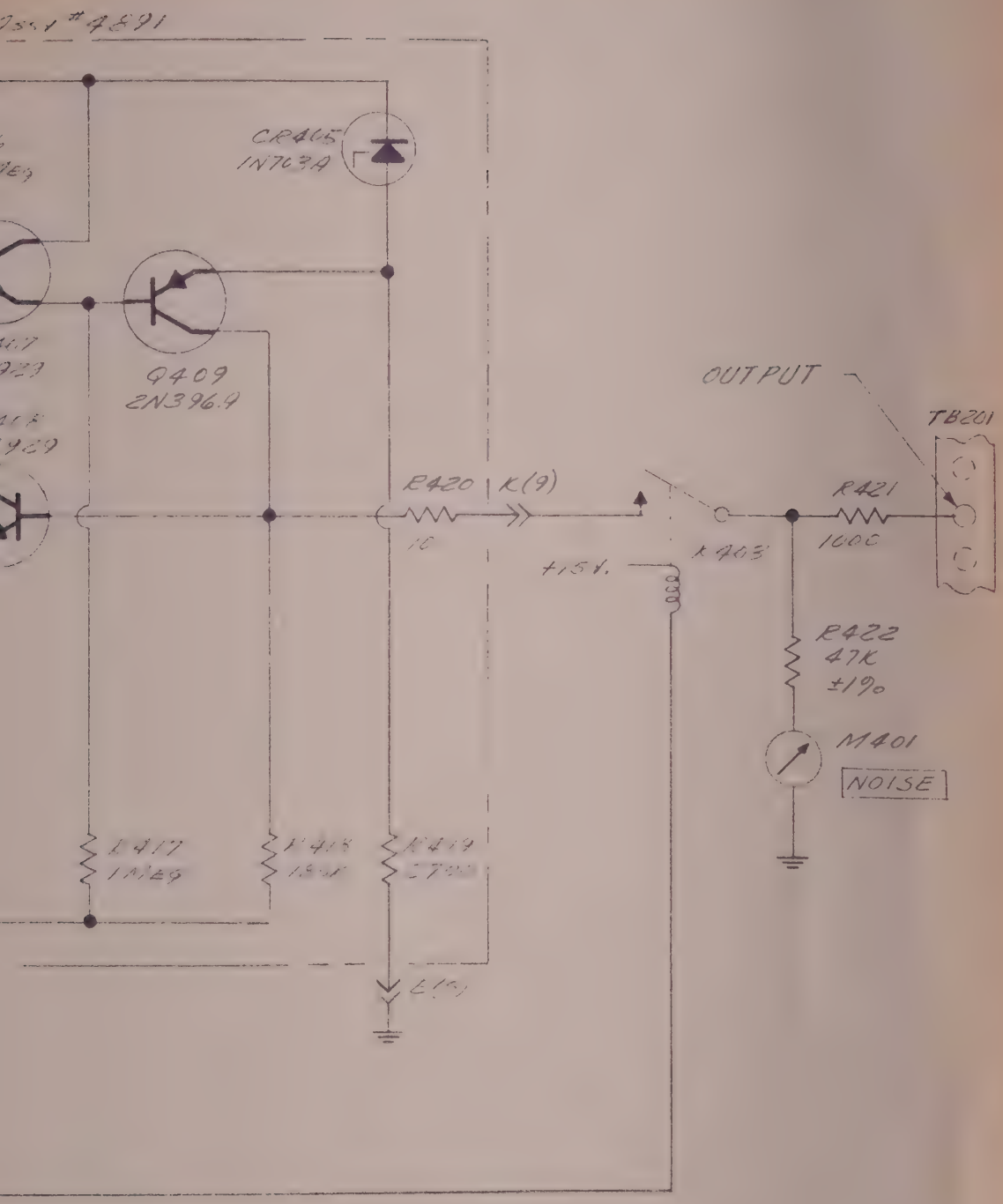
SCHEMATIC
CALIBRATE AMPL. & DETECTOR
MODEL 2214

T-4883-B


INTEGRATOR
+15V.
Bd # 4096 Ass'y # 4890
F(6)
CR404
IN703A
Q401
2N929
R402
100
±1%
SECOND
R401
62
R403
400
±1%
1Ω
10Ω
30Ω
R404
16K
±1%
CR401
IN482A
CR402
IN482A
A(1)
F(5)
-18V
K401
+15V.
3 SEC
10 SEC
30 SEC
S401B
TB201
R405
100
+15V.
K402
To Trigger Delay
Bd # 4817, Ass't # 4892, Pin J(8)
To Detection Bd # 4866 Ass'y # 4883, Pin C(3)
To Int. Time
Bd # 4817, Ass't # 4892, Pin H(7)
To Integrator Time

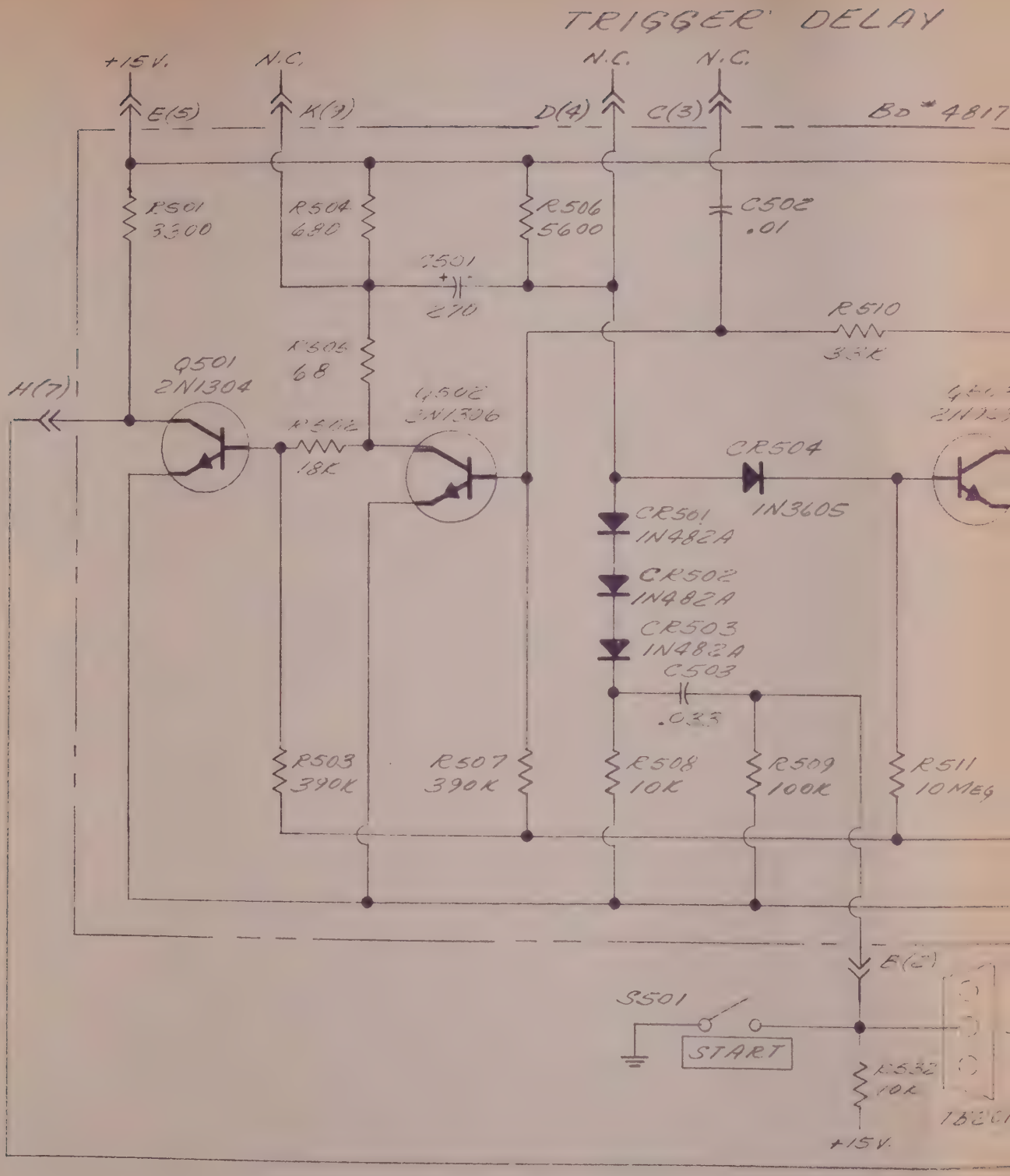

+15V.
F(6)
Bd # 4053
R411
680
R412
E40K
R414
C.3Meg
C402
R408
330
R409
5600
R410
R415
4.7Meg
J.5)
-18V.

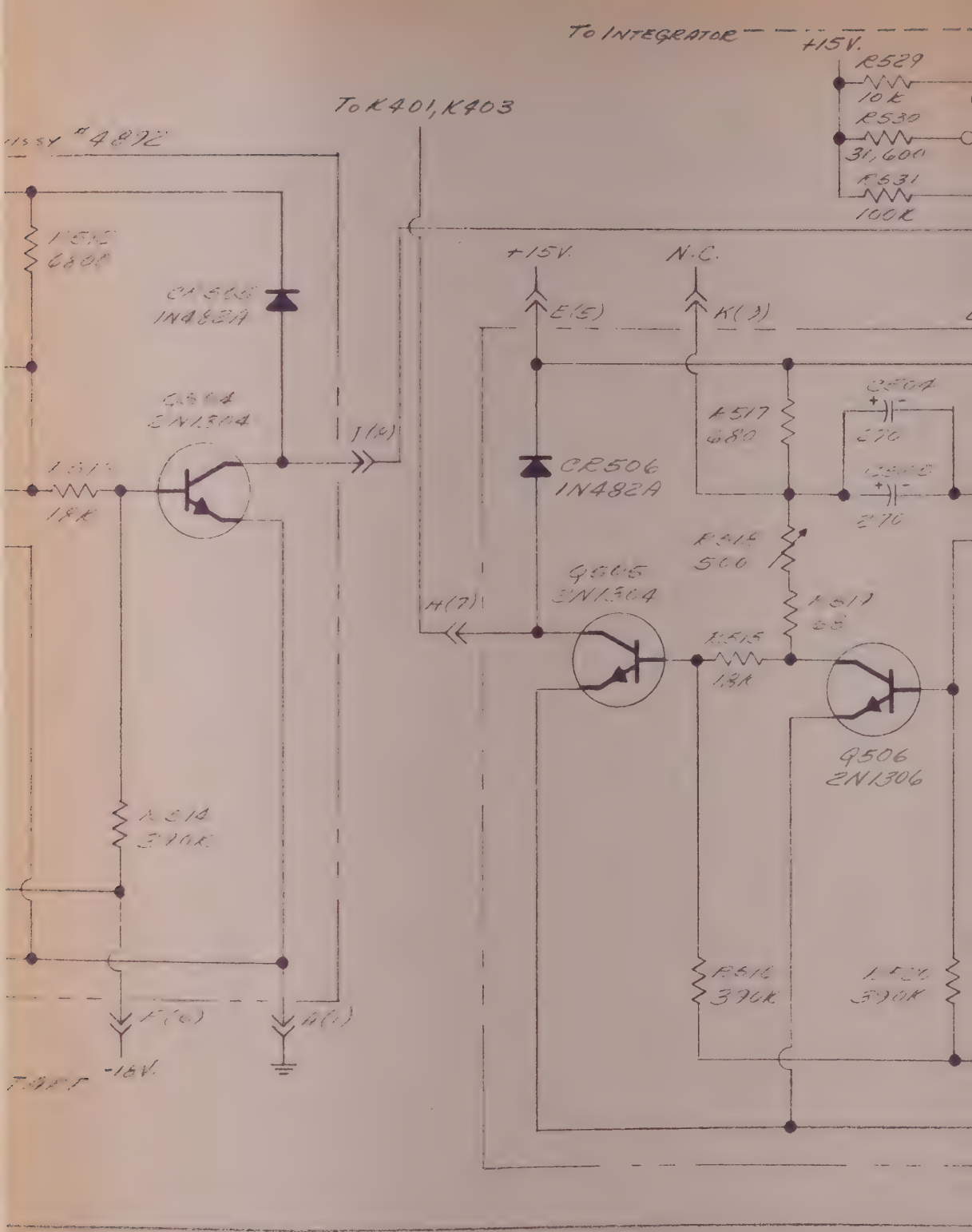
DRIVE

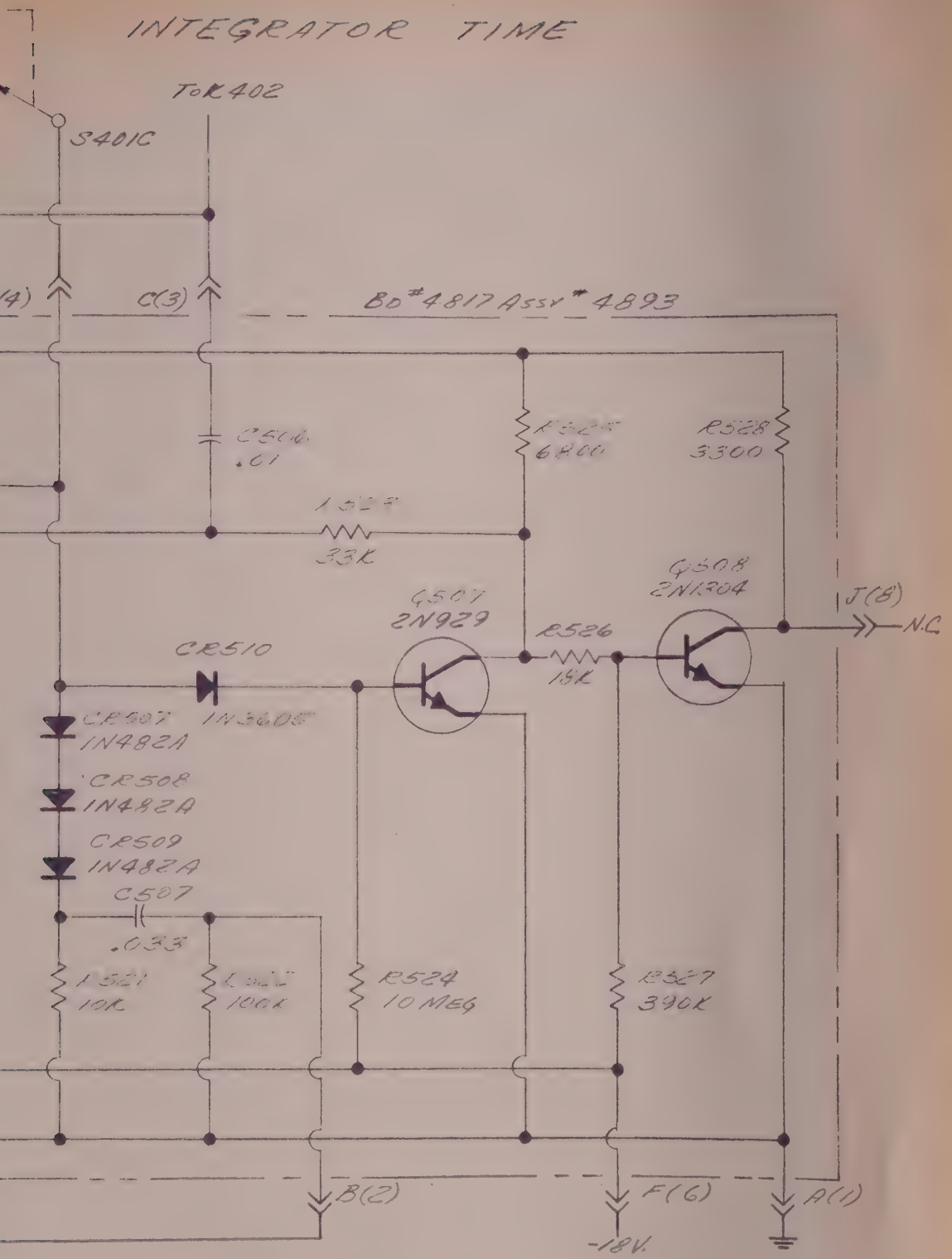


SCHEMATIC
INTEGRATOR & METER DRIVE
MODEL 2214

T-4884-B


TRIGGER DELAY
+15V.
N.C.
N.C.
N.C.
E(5)
K(3)
D(4)
C(3)
Bd "4817
R501
3300
R504
680
R506
5600
C502
.01
C501
270
R510
3.3K
R505
68
Q501
2N1304
H(7)
R502
18K
Q502
2N1306
CR504
IN3605
CR501
IN482A
CR502
IN482A
CR503
IN482A
C503
.033
R503
390K
R507
390K
R508
10K
R509
100K
R511
10 Meg
E(2)
S501
START
R532
10K
+15V.


To Integrator
+15V.
R529
10K
R530
31,600
R531
100K
To K401, K403
+15V.
N.C.
E(5)
K(3)
CR505
IN482A
CR504
IN1304
J(4)
CR506
IN482A
R517
680
C504
C505
270
270
R516
500
R518
68
Q505
2N1304
H(7)
R515
1.8K
Q506
2N1306
R514
390K
R512
390K
R520
390K
F(6)
A(1)
-15V.



SCHEMATIC
TRIGGER DELAY & INT. TIME
MODEL 2214

T-4885-B

Short Form Catalog

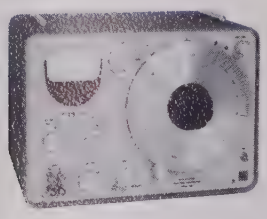
INSTRUMENTS • AMPLIFIERS • NOISE INSTRUMENTATION

Quan-Tech®

GENERAL INSTRUMENTS

• ELECTRONIC INSTRUMENTS • ANALYZERS • AMPLIFIERS • SPECIAL INSTRUMENTS •

WAVE ANALYZERS



MODEL 303
WAVE AND NOISE SPECTRUM ANALYZER

Frequency range: 30 cps to 100 Kc. **Bandpasses:** 10, 30, 100, 1000 cps, selectable at front panel. (100 and 1000 cps bandwidths flat-topped for simplified noise computation, greater accuracy and convenient tuning. **Sensitivity:** 100 μv to 300 v, FS. Down to 1 μv FS with accessory Model 203 preamplifier (see below). ±300 cps vernier; selection of long or short meter time constants; metering circuits compensated to minimize error from instantaneous noise pulses; overload-protected meter; analog output for external monitoring. **Price:** $1475

MODEL 2156 WAVE AND SPECTRUM ANALYZER

Similar to above except: **Frequency range:** 10 cps to 30 Kc. **Bandpasses:** 3, 10, 30, 300 cps. **Price** $1950

MODEL 304
LOW FREQUENCY WAVE & SPECTRUM ANALYZER

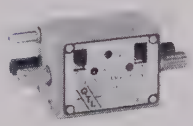
Frequency range: 1 cps to 5 Kc; **Bandpasses:** 1, 10 & 100 cps, selectable at front panel; **Skirt Selectivity:** 24 DB per 1/2 bandwidth; **Voltage range:** 30 μV to 100 v, FS; down to 3 μV FS with accessory Model 201B preamplifier (see below); **Tuning:** Manual or automatic; internally supplied electronic sweep of total frequency range or of any portion; provision for external sweep; **Frequency Calibration:** Linear; **Outputs:** BFO, sample of automatic sweep, analogs of meter readings and frequency setting, phase output for phase plot on X-Y recorder. **Price:** $2350

OPTIONAL FEATURES

Pen lift; AFC; Log, squared, or RMS meter reading; slave operation for multi-channel analyzer system. Prices: Upon request.

SOLID STATE AMPLIFIERS

MODEL 201B
DC DECADE AMPLIFIER
AC OR DC COUPLED

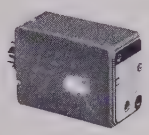


Bandwidth: DC or 10 cps to 3Mc (3db); **Gain:** 10 (fixed); Power: Self-contained batteries; 600 hour life. **Price:** $110

MODEL 203
LOW NOISE AC AMPLIFIER

Bandwidth: 30 cps to 100 Kc (±0.5 db); —3 db at 500 Kc; **Gain:** 100 (fixed); **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. Battery powered; **Price:** $125

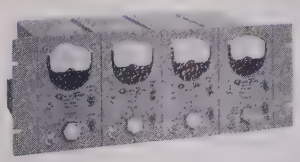
MODEL 205
HIGH-STABILITY DC AMPLIFIER



Bandwidth: dc to 100 Kc (0.5 db down); 3 db down at approx. 500 Kc; **Gain:** 10 (fixed); **Typical drift:** less than 250 μv at constant ambient, input shorted. External + & — 12 v required. **Price:** $105

MODEL 206
SELECTABLE GAIN AC AMPLIFIER

Bandwidth: 10 cps to 100 kc (within 0.5db); —3db at 500 Kc. **Typical noise:** 5×10^{-9} v and 3×10^{-12} a per root cycle at 1 Kc. **Gain:** 10, 100 & 1000, selectable at front panel; **Power:** 105-125 v AC or optional self-contained battery pack (automatically recharging). **Price:** $165, Batteries $25.



MODELS 2182 AND 2220
AC INSTRUMENTATION AMPLIFIERS

Modular rack mounted amplifiers having controlled gain vs frequency characteristics. **Max voltage gain:** 10,000. **Attenuation:** 0-75 db in 5 db steps. **Frequency characteristics:** (selected by plug-in cards) voltage gain flat 10 cps to 100 Kc or 10 cps to 20 Kc, rising 3 db/octave 10 cps to 100 Kc or 6 db/octave 10 cps to 20 Kc. **Power:** 105-125 VAC.

MODEL 2182 (shown) mounts four units in a 7" x 19" rack panel. **Price** $455.

MODEL 2220 (not metered) mounts eight units in 7" x 19" rack panel. **Price** $590.

SPECIAL INSTRUMENTS

Quan-Tech manufactures a great many "specials", ranging from one unit only to production quantities on an OEM basis. Our engineering department is extremely flexible and equipped to handle anything from minor modifications of standard instruments to the design and construction of an extremely complicated fully automatic noise measuring system. We are proud of our ability to meet difficult specifications that challenge the state of the art for low noise, stability, and accuracy. Your inquiry will receive a prompt reply.

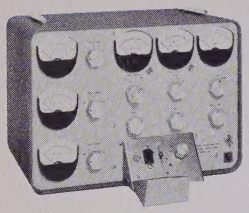
All prices shown are F.O.B. Whippany, N. J. Prices and specifications subject to change without notice.

Quan-Tech LABORATORIES, INC.

43 SO. JEFFERSON ROAD, WHIPPANY, NEW JERSEY - 07981 • PHONE (201) 887-5508

Quan-Tech®

NOISE INSTRUMENTS



MODEL 310 TRANSISTOR NOISE ANALYZER

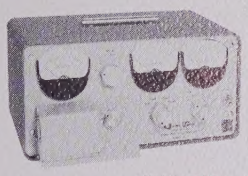
Measures noise current and voltage at 100 cps, 1 Kc and 10 Kc, as well as I_{cbo}, I_{ebo} and beta. **Noise voltage range:** 0.01 to 3 μv/root cycle, FS. **Noise current range:** 1 to 300 pa/root cycle, FS. **Collector current range:** 0.05 to 30 ma. **Collector voltage range:** 0.1 to 30 v. **Base resistance range:** 0, 500, 1K, 10K plus external position. **Price:** $2375

MODEL 311 TRANSISTOR NOISE ANALYZER

Similar to above, except that collector current range is from 5 to 1000 μa for noise measurement in low-collector-current devices. Measures Gm instead of beta. Also measures FET's. **Price:** $2575

MODEL 312 TRANSISTOR NOISE ANALYZER

Similar to Model 310, but designed for measurement of field-effect transistors. **Drain voltage range:** 0.1 to 30 v. **Drain current range:** 0.05 to 30 ma. **Gate Bias range:** 1 v forward to 15 v reverse, continuously adjustable. Also measures transconductance. **Price:** $2575.



MODEL 510 TRANSISTOR NOISE ANALYZER

Similar to Model 310 except that it measures noise current and voltage at 1 Kc only. No beta or leakage measurements. **Noise voltage range:** 0.01 to 3 μV/root cycle FS. **Noise current range:** 1 to 300 pa/root cycle FS. **Collector voltage range:** 3 to 30v. **Collector current range:** 0.1 to 10 ma. **Base resistance range:** 0, 500, 1K, 10K ohms plus external position. Also measures FET's. **Price:** $10.05

MODEL 511 TRANSISTOR NOISE ANALYZER

Identical with Model 510 except **Collector current range:** 3 to 300 μa. **Price:** $1145

MODEL 512 TRANSISTOR NOISE ANALYZER

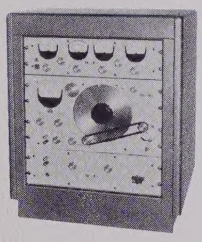
Similar to Model 510 except that it measures broadband (10 cps to 15.7 Kc) noise figure. **Collector current range:** 10 μa to 1 ma. **Price:** $1145.

MODEL 2173-2181 TRANSISTOR NOISE ANALYZER

The most versatile unit available. Measures noise current and voltage at 10 and 100 cps, 1, 10, and 100 Kc simultaneously. **Noise voltage range:** 3 to 3000 nanovolts/root cycle FS. **Base resistance range:** 0, 500, 1K, 10K, 100K, and 1M ohms plus external position. **Collector voltage range:** 0.3 to 60 volts. **Collector current range:** 0.3 μa to 30 ma. Also measures FET's. **Price:** $4950.

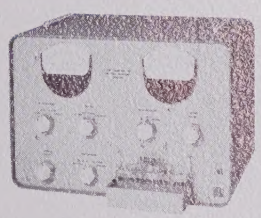
VERY LOW FREQUENCY NOISE ANALYZER

On special order we can supply a test jig and preamplifier for use with the Model 304 Low Frequency Wave and Spectrum Analyzer for making noise measurements at frequencies down to 1 cps. Write us outlining your requirements.



MODEL 2158 NOISE ANALYSIS SYSTEM

Measures noise in any component or system from 30 cps to 100 Kc. Consists of Model 303 Wave Analyzer with motor driven sweep, two preamplifiers, and two metered power supplies. **Preamplifier gain:** 10, 100, 1K, and 10K. **Input impedance:** 100K + 50 pf or 10 meg + 50 pf. **Typical input noise:** 4 x 10^{-9} V and 2 x 10^{-12} A (100K input), 8 x 10^{-9} V and 6 x 10^{-14} A (10 meg input), per root cycle at 1 Kc. **Power Supplies:** 0.1 to 30 volts and 1 to 450 volts at 100 ma. each. Overload protected. **Ripple:** 1 microvolt max. **Price:** $5200.

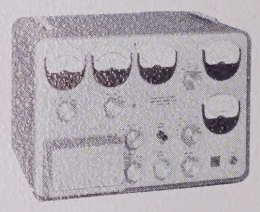


MODEL 315 RESISTOR NOISE TEST SET

Measures noise in resistors in conformance with specifications recommended by NBS and Method 308 of MIL STD 202B. **Test-resistor range:** 100Ω to 22 meg Ω. **Measurement range:** 0.6 μv in a decade to 1000 μv in a decade. **Outputs:** Sample of noise voltage; analogs of meter readings. External cable supplied for remote location of test jig. **Price:** $1950

MODEL 2136

Similar to above, but measures resistors down to 10 Ω. **Price:** $2300



MODEL 327 DIODE NOISE ANALYZER

Measures noise in back-biased semi-conductor diodes at 10 cps and 1 Kc simultaneously. **Noise voltage range:** 0.03 μv to 1 mv/cycle of bandwidth. **Test voltage:** 0 to 500v, continuously variable. **Test current:** 0 to 100 ma, continuously variable. Internally supplied ramp automatically sweeps test current and/or voltage within maximum ratings. A wide variety of outputs for data logging, external monitoring, actuating external equipment, etc. **Price:** $2750

TEST JIG AND TRANSFORMER

For measuring noise in forward-biased diodes up to 100 ma. **Price:** $300.

MODEL 317 AMPLITUDE DISTRIBUTION ANALYZER

Determines amplitude - probability distribution of random signals. **Amplifier response:** 3 db down at approx. 12 cps and 1 Mc; **Switching rate:** 5 Mc; **Amplitude ranges:** 100%, 10%, 1% FS; Normal or "inverted" operation; provision for external sweep of level. **Price:** $450

MODEL 420 RANDOM NOISE GENERATOR

Stable "white" noise output having true gaussian amplitude distribution. **Frequency range:** dc to 100 Kc; **Output voltage:** 0.01 to 1000 μv/root cycle, continuously variable, calibrated; **DC offset:** less than 10 mv at max. output. **Price:** $525

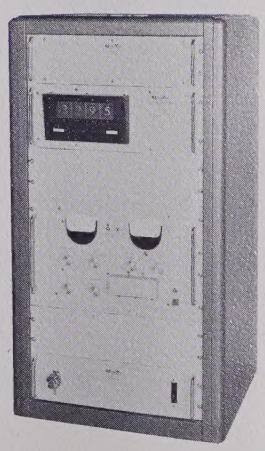
MODEL 2184 DIGITAL RESISTOR NOISE TEST SYSTEM

Digitizes, stores, and presents resistor noise data. Consists of Model 2136 Resistor-Noise Test Set plus three digital voltmeters, storage, timing circuits, and optical and punch-card readout. Automatic sequence converts, sums, and stores five total noise readings, five system noise readings, and applied DC voltage. Presents three data channels simultaneously to punch-card system, plus selectable optical readout of any channel. All digital circuitry designed and built by Quan-Tech. **Price:** $9500.

MODEL 2170-71-72 AUTOMATIC RESISTOR NOISE TEST SYSTEM

High-speed automatic sorting of resistors by Noise Index. Sorts 3000/hr. at ± 1 db tolerance, 6000/hr. at ± 3 db tolerance. Higher speeds obtainable by adding additional channels. **Price:** $12,900. (less mechanical handling)

The above systems and modifications of them can be adapted to measuring noise in transistors and diodes. Write us outlining your requirements.



43 SO. JEFFERSON ROAD, WHIPPANY, NEW JERSEY - 07981 • PHONE (201) 887-5508

A Word About Noise Analysis

Since 1957 when it was founded, Quan-Tech Laboratories has specialized in the amplification and measurement of extremely low level signals approaching the theoretical limits of sensitivity. In order to build equipment of this sort it was necessary to select components having the lowest possible electrical noise for use in the most sensitive parts of the circuit. Noisier components were relegated to places where (it was thought) their noise would not interfere with proper operation. These noisy components exhibited a very high rate of failure compared to the quiet ones, so an intensive study of the reasons for these failures was undertaken.

Investigation showed that those components which exhibited excessive amounts of noise (particularly of the "1/f" type) compared to similar units, usually contained some defect or abnormality which could lead to early failure. This was equally true of resistors, transistors, and diodes, even though the failure mechanism might be different for each device.

This discovery led to the development of specific electrical noise measuring instruments for each type of component. Cooperative programs with manufacturers have proved beyond doubt that noise measurements, properly applied, can locate many types of failure-prone components before they are placed in the circuit, with resultant cost saving and increased reliability. Even manufacturers of such fiercely competitive items as automobile radios, electronic organs, and hearing aids have found noise screening cuts costs and improves product quality.

If you haven't already investigated the benefits of noise analysis, both for reliability and for very low noise applications, why not contact us or our local representative and get the full story?

Quan-Tech Sales Representatives

New England

VECTOR SALES, INC.
301 Belmont St.
Belmont, Mass. 02178
617-489-1400

P.O. Box 87
Milford, Conn.
203-TR4-2112

New York,

LINDGREN ASSOCIATES
605 Palmer Drive
North Syracuse, N.Y. 13212
315-GL8-3113

New York City Area, New Jersey, Eastern Pennsylvania

L & M ASSOCIATES
P.O. Box 641
Fair Lawn, N. J. 07411
201-DI3-3070

P.O. Box 4242
Philadelphia, Pa. 19144
215-GE8-5666

Washington, D. C., Maryland, Delaware, Virginia

PADDOCK-JOSLOW COMPANY
P.O. Box 192
Silver Spring, Md. 20907
301-589-6554

Ohio, Michigan, Western Pennsylvania, Kentucky, West Virginia

COMPONENTS ENGINEERING CO.
7461 N. Linden Lane
Cleveland, Ohio 44130
216-842-2737

11820 Knollsprings
Cincinnati, Ohio 45246
513-825-8686

N. & S. Carolina Tennessee, Alabama, Georgia, Florida, Mississippi, Louisiana, Texas (except El Paso) Arkansas, Oklahoma

ROY ATTAWAY CO.
51-53 E. Robinson St.
Orlando, Fla. 32801
305-424-9983
305-424-5328

519 Nissen Bldg.
Winston-Salem, N.C. 27101
919-722-9671

900 Bob Wallace Ave.
Huntsville, Ala. 35801
205-534-2811

7401 Gulf Freeway, Suite 106
Houston, Texas 77017
713-649-7874

Dallas Phone
214-528-9040

Illinois, Indiana, Iowa, Wisconsin, Minnesota, Missouri, Kansas

COZZENS & CUDAHY, INC.
125 Old Orchard Arcade
Skokie, Ill. 60079
312-OR5-6700

925 E. Abert Place
Milwaukee, Wis. 53211
404-ED2-0700

9725 Girard Ave. So.
Minneapolis, Minn. 55431
612-881-2121

6050 Brown Rd.
St. Louis, Mo. 63134
314-521-3034

6142 Prospect Ave.
Kansas City, Mo. 64130
816-444-8595

Washington, Oregon

J. K. DOOLEY CO., INC.
4110 Stone Way N.
Seattle, Washington 98103
206 - ME 2-1618

Northern California

JAY STONE & ASSOCIATES
140 Main St.
Los Altos, Calif. 94022
415-WH8-4563

Southern California, Arizona

A-F SALES ENGINEERING, INC.
94 So. Los Robles Ave.
Pasadena, Calif. 91101
213-MU1-5631
213-SY5-7081

Canada

ATLAS INSTRUMENT CORP.
50 Wingold Ave.
Toronto 19, Ontario
416-RU1-6179

3333 Cavendish Blvd., Suite 390
Montreal, Quebec
514-HU9-8495

342½ Elgin St.
Ottawa, Ontario
613-CE3-9471

909 Beach Avenue
Vancouver, B. C.
604-MU4-7927

All Export (Except Canada)

SYLVAN GINSBURY, LTD.
72 West 45th Street
New York, N. Y. 10036
212-MU7-3213

Quan Tech LABORATORIES, INC.

43 SO. JEFFERSON ROAD, WHIPPANY, NEW JERSEY - 07981 • PHONE (201) 887-5508

Printed in U.S